Cost and Scheduling of Magnet Fabrication (WBS 2.1)

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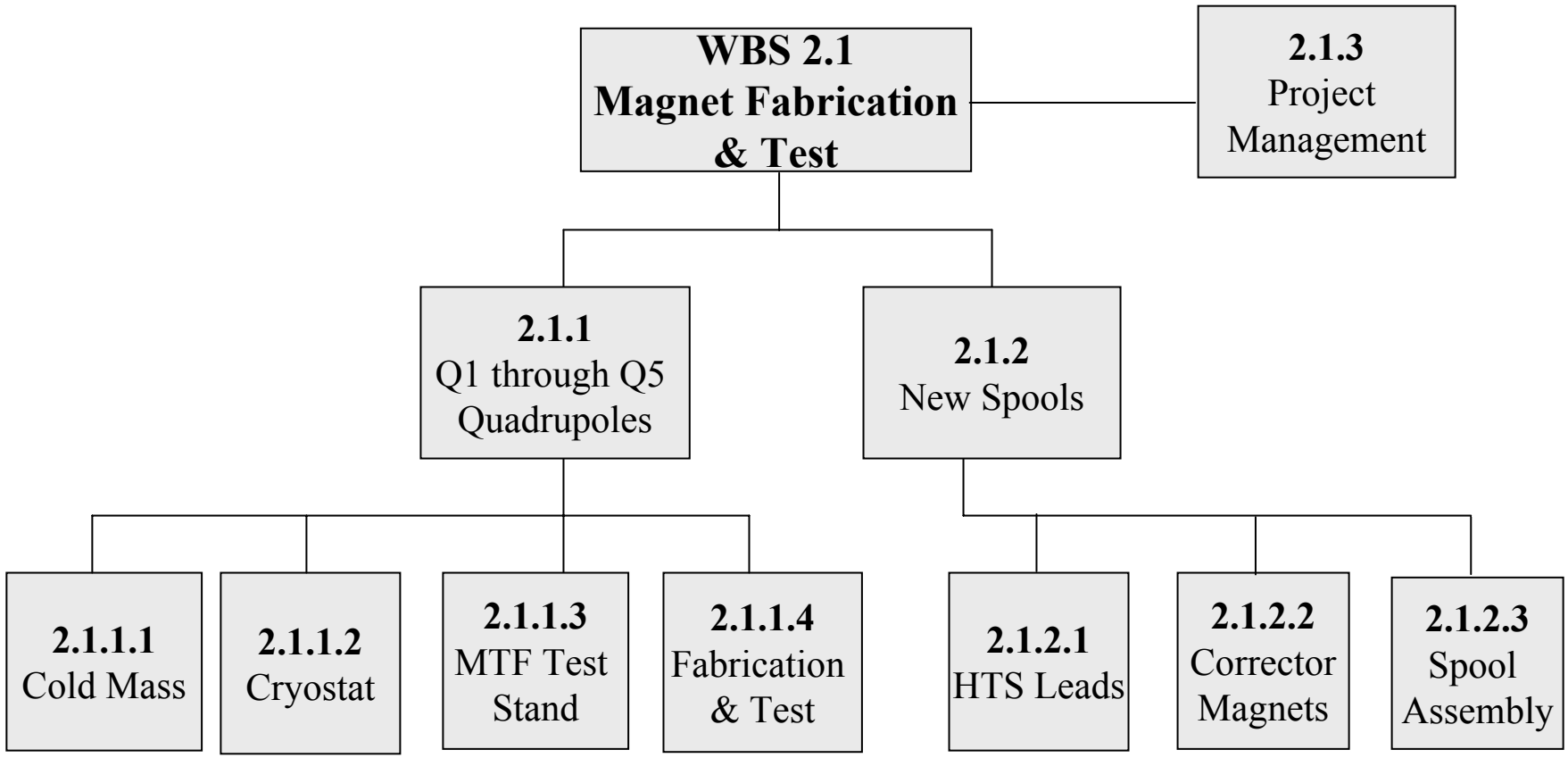
- Organization
- Construction Cost
  - Quadrupoles
  - HTS Leads
  - Corrector Magnets
  - Spool Assembly
  - MTF Test Stand
- Overall Schedule
- Key Milestones
- Critical Path Analysis
- Risk Analysis
- Summary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Construction Cost

- Basis of Estimate – Quadrupoles
  - Superconductor: ~ 0.8 M$ (based on quotation from Oxford dated December 2003)
  - Collar Steel: ~ 0.1 M$ (based on quotation dated December 2003)
  - Rest of the components scaled based on LHC experience
    - A more detailed break-down of procurement costs is currently being developed
  - Labor from LHC production experience
- Basis of Estimate – HTS Leads
  - Assume current design, operating at present rating. Require 22 pairs including 9 spares and one for TeV bus
  - Estimate based on HTS leads procured from ASC; P.O. # 517360 dated May 2000.
  - Vendor visits have begun to gauge their interest and to get a better cost estimate
  - Uncertainty in the number of leads – could drive the cost down by a factor of 2

Construction Cost WBS 2.1

- Basis of Estimate – Corrector Magnets
  - Cos n(theta) is the baseline design. Require 28 corrector packages including 12 spares
  - Basis of estimate is CERN corrector magnets which are fabricated in European industry
  - Communication with other labs (BNL, IHEP, & CAT) have begun to outsource corrector fabrication and test
  - Biggest uncertainty in cost
- Basis of Estimate – Spool Assembly
  - Fermilab design; fabricated and assembled in industry and tested in Fermilab
  - Basis of estimate is LHC DFBX experience
  - Require 15 spools including 5 spares
  - At least one vendor capable and showing interest

- MTF Test Stand
  - Dedicated Tevatron / BTeV Stand to test different Quads and Spools
  - Basis of Estimate is LHC experience
    - Stand design updated for BTeV requirements
    - Design and commissioning time included
    - Conventional Power leads
    - Modest instrumentation

Construction Cost

WBS 2.1

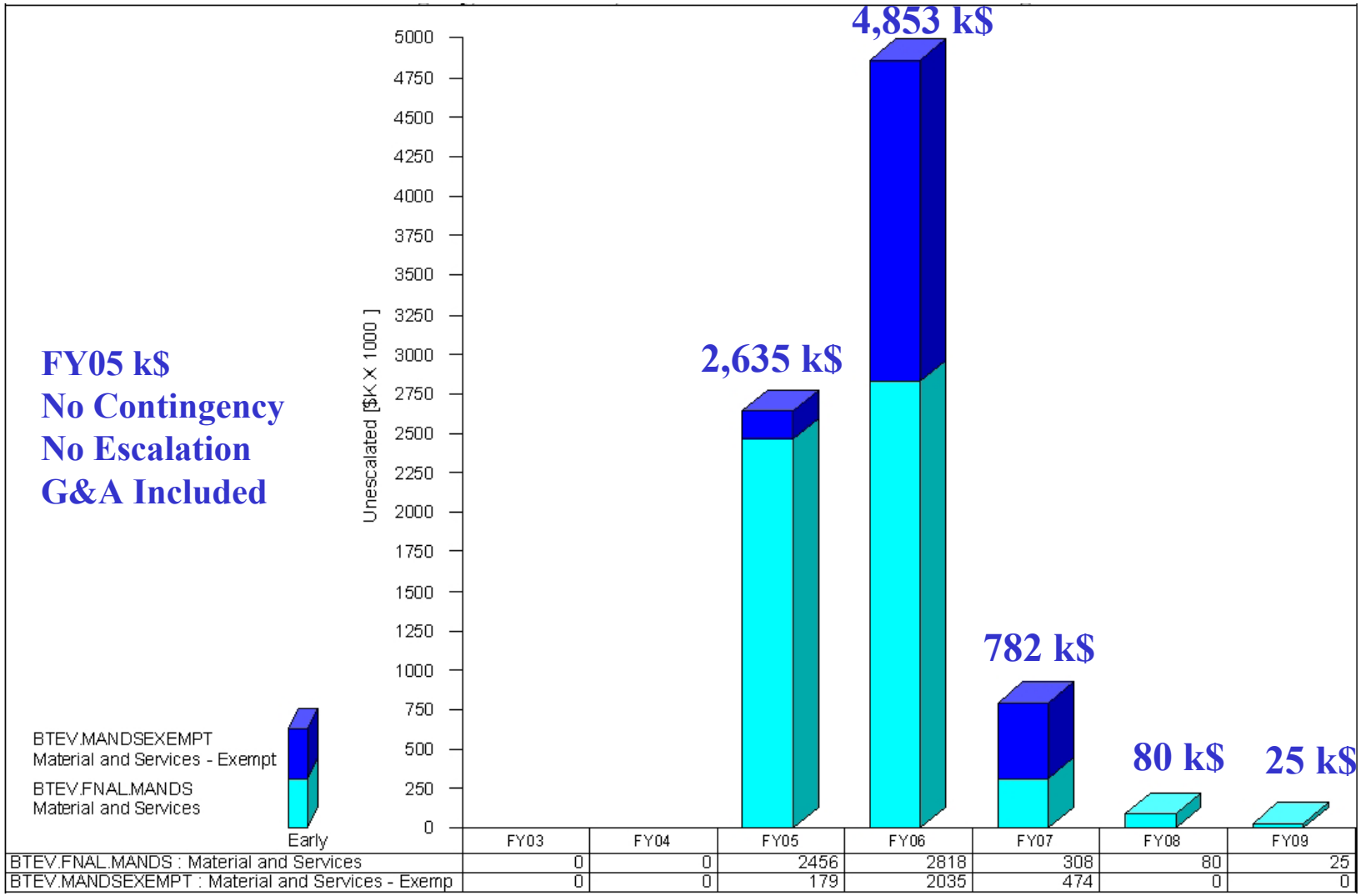
WBS	SubProject	FY05		FY06		FY07		FY08		FY09		Base Total	
		M&S	Labor	M&S	Labor	M&S	Labor	M&S	Labor	M&S	Labor	M&S	Labor
2.1.1.1	Cold Mass Design and Procurement	1404	463	847	403	0	0	0	0	0	0	2251	866
2.1.1.2	Crostat Design and Procurement	355	492	346	282	0	0	0	0	0	0	701	774
2.1.1.3	MTF Test Stand	76	260	283	335	0	187	0	0	0	0	359	782
2.1.1.4	Q1 through Q5 Fabrication & Test	0	0	0	397	52	1342	53	1334	12	268	117	3341
2.1.2.1	HTS Leads	447	27	398	36	119	95	0	0	0	0	964	158
2.1.2.2	Corrector Magnets	353	127	353	65	0	41	0	35	0		706	268
2.1.2.3	Spool Assembly	0	516	2625	358	611	242	27	373	13	194	3276	1683
2.1.3	Project Management	0	179	0	184	0	180	0	180	0	114	0	837
TOTAL		2635	2064	4852	2060	782	2087	80	1922	25	576	8374	8709

Total Base Cost (incl. G&A) = 17,083 k$
Cost with Contingency = 23,776 k$

Costs are in FY05 $
Almost all activities have 40% contingency

M&S Cost Profile by Fiscal Year

WBS 2.1

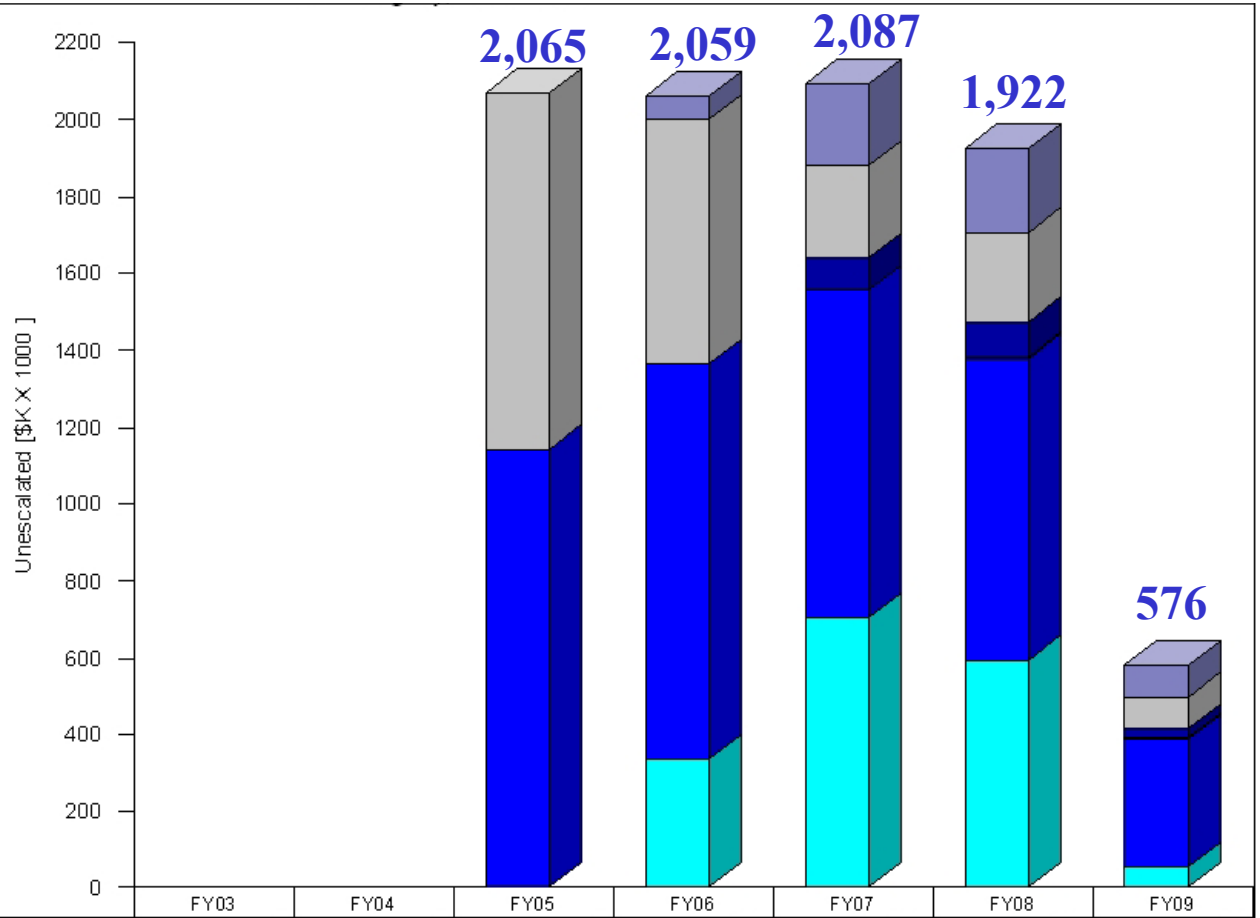


	FY03	FY04	FY05	FY06	FY07	FY08	FY09
BTEV.FNAL.MANDS : Material and Services	0	0	2456	2818	308	80	25
BTEV.MANDSEXEMPT : Material and Services - Exemp	0	0	179	2035	474	0	0

Labor Cost Profile by Fiscal Year

WBS 2.1

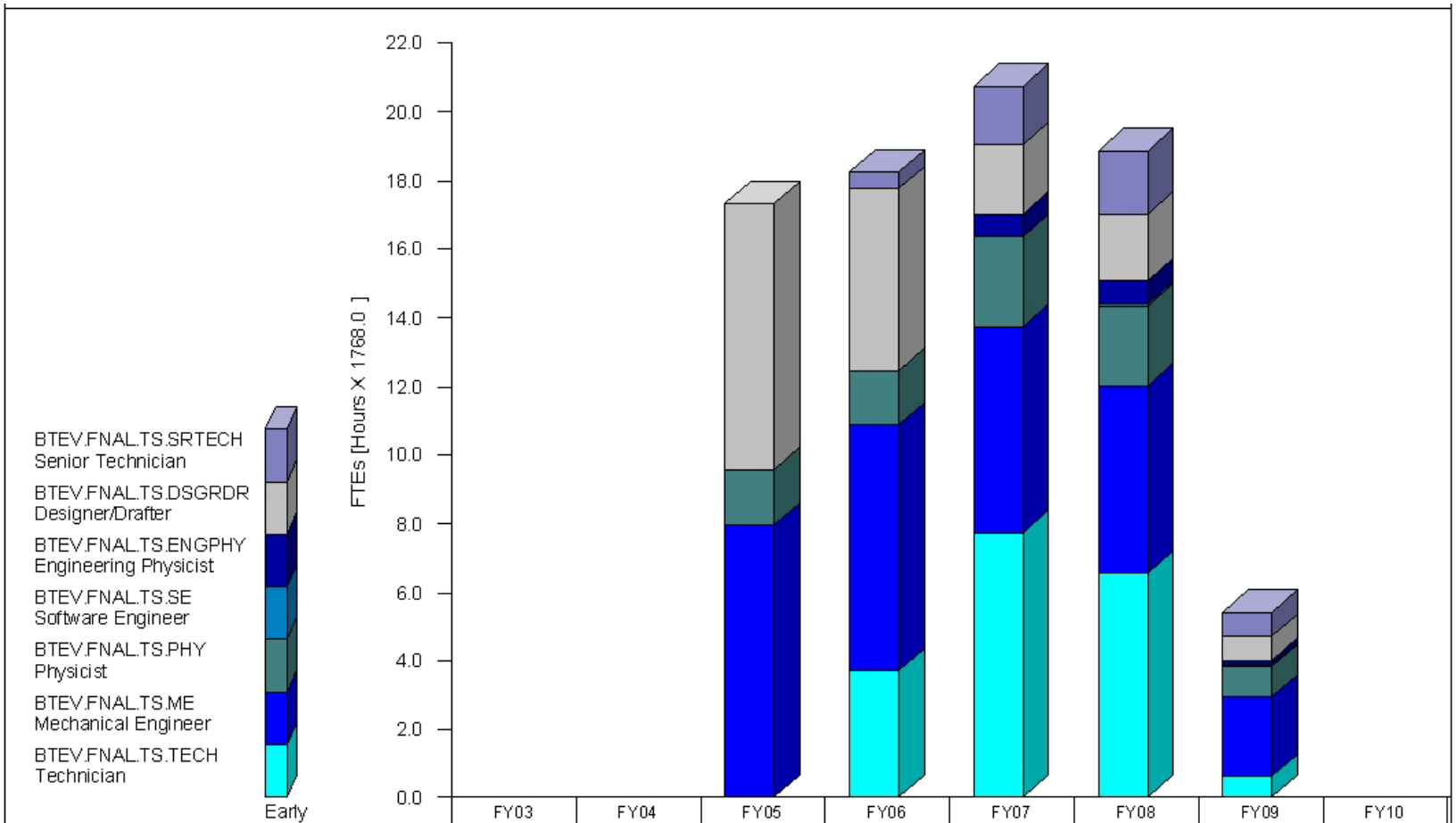
FY05 k$
No Contingency
No Escalation
G&A Included



	FY03	FY04	FY05	FY06	FY07	FY08	FY09
BTEV.FNAL.TS.TECH : Technician	0	0	0	330	698	589	52
BTEV.FNAL.TS.ME : Mechanical Engineer	0	0	1136	1032	856	784	333
BTEV.FNAL.TS.PHY : Physicist	0	0	0	0	0	0	0
BTEV.FNAL.TS.SE : Software Engineer	0	0	0	0	2	4	2
BTEV.FNAL.TS.ENGPHY : Engineering Physicist	0	0	0	0	83	93	23
BTEV.FNAL.TS.DSGRDR : Designer/Drafter	0	0	929	634	241	233	84
BTEV.FNAL.TS.SRTECH : Senior Technician	0	0	0	62	207	219	83

Labor Profile by Fiscal Year

WBS 2.1

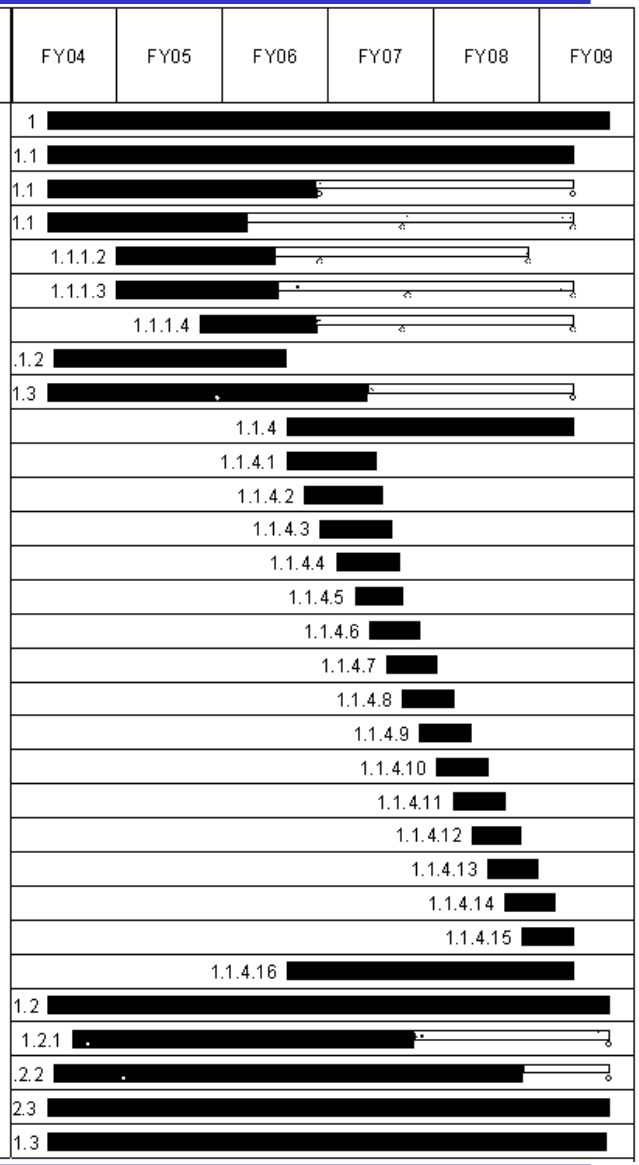


	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10
BTEV.FNAL.TS.TECH : Technician	0.0	0.0	0.0	3.7	7.7	6.5	0.6	0.0
BTEV.FNAL.TS.ME : Mechanical Engineer	0.0	0.0	7.9	7.2	6.0	5.5	2.3	0.0
BTEV.FNAL.TS.PHY : Physicist	0.0	0.0	1.6	1.6	2.6	2.3	0.9	0.0
BTEV.FNAL.TS.SE : Software Engineer	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BTEV.FNAL.TS.ENGPHY : Engineering Physicist	0.0	0.0	0.0	0.0	0.6	0.7	0.2	0.0
BTEV.FNAL.TS.DSGRDR : Designer/Drafter	0.0	0.0	7.8	5.3	2.0	1.9	0.7	0.0
BTEV.FNAL.TS.SRTECH : Senior Technician	0.0	0.0	0.0	0.5	1.7	1.8	0.7	0.0

Schedule

WBS 2.1

Activity ID	Activity Description	Original Duration	Early Start	Early Finish
1	New magnet fabrication and test	1347d	02Feb04	01Jun09
1.1	LHC-type Quadrupoles	1260d	02Feb04	28Jan09
1.1.1	COLD MASS	651d	02Feb04	23Aug06
1.1.1.1	Cold Mass Component Design	480d	02Feb04	23Dec05
1.1.1.2	Cold Mass Tooling Design	380d	01Oct04	03Apr06
1.1.1.3	Cold Mass Component Procurement	390d	04Oct04	18Apr06
1.1.1.4	Cold Mass Tooling Procurement	280d	21Jul05	23Aug06
1.1.2	Q1 through Q5 CRYOSTAT	560d	01Mar04	12May06
1.1.3	MTF TEST STAND	771d	02Feb04	15Feb07
1.1.4	Q1 through Q5 PRODUCTION	680d	15May06	28Jan09
1.1.4.1	174-1	211d	15May06	15Mar07
1.1.4.2	174-2	191d	12Jul06	12Apr07
1.1.4.3	174-3	171d	07Sep06	10May07
1.1.4.4	97-1	151d	02Nov06	08Jun07
1.1.4.5	97-2	120d	03Jan07	21Jun07
1.1.4.6	97-3	120d	01Mar07	17Aug07
1.1.4.7	97-4	120d	26Apr07	15Oct07
1.1.4.8	97-5	120d	22Jun07	12Dec07
1.1.4.9	97-6	120d	20Aug07	13Feb08
1.1.4.10	75-1	120d	16Oct07	09Apr08
1.1.4.11	75-2	120d	13Dec07	05Jun08
1.1.4.12	75-3	120d	14Feb08	01Aug08
1.1.4.13	54-1	120d	10Apr08	29Sep08
1.1.4.14	54-2	120d	06Jun08	26Nov08
1.1.4.15	54-3	120d	04Aug08	28Jan09
1.1.4.16	Production Oversight in ICB	680d	**15May06**	**28Jan09**
1.2	New Spools	1347d	02Feb04	01Jun09
1.2.1	HTS LEADS	817d	03May04	24Jul07
1.2.2	CORRECTOR MAGNETS	1122d	01Mar04	05Aug08
1.2.3	SPOOL ASSEMBLY	1347d	02Feb04	01Jun09
1.3	Project Management	1341d	02Feb04	21May09



Schedule

- Quadrupoles
  - Production plan developed working backwards and including some schedule float before installation…
  - Procurement of Superconductor to start in October 04
  - Coil winding for the first production magnet to start in May 06
  - MTF test stand and Cryostat drive the schedule (in that order)
- HTS Leads
  - Production to start in October 05
  - The level of response from potential vendors could drive the schedule
- Corrector Magnets
  - Prototype fabrication to start in March 06
  - The working model is to have an outside vendor fabricate and test the magnets
  - Currently investigating various options to identify a suitable vendor

- Spool Assembly
  - Prototype fabrication to start in May 07
  - Current working model is to design the spool assembly in-house, fabricate them outside and then test in Fermilab
  - Fabrication and test of spool assembly drives the overall schedule of WBS 2.1

Key Milestones

- Request for Proposal (RFP) for Superconductor – Oct 04
- Start Quadrupole Fabrication @ Fermilab – May 06
- RFP for HTS Leads – Jan 05
- RFP for Corrector Magnets – April 05
- Start Spool Fabrication @ Outside Vendor – May 07
- Finish Quadrupole Fabrication & Test – Feb 09
- Finish Spool Assembly Fabrication & Test – May 09

Critical Path Analysis

- Spool Assembly
  - The completion of the C0 IR subproject is dictated by the spool assembly fabrication and test
  - Design of spool assembly is in the critical path followed by the delivery of corrector magnets
- MTF Test Stand
  - Needed for the first quadrupole test. Could drive the quadrupole fabrication and test schedule
- Superconductor
  - Long lead item

Risk Analysis

- **Risks**
  - **Superconductor Procurement**
    - **Long lead item**
  - **HTS Leads**
    - **Vendor interest needs to be explored**
  - **Corrector Magnets**
    - **Vendors not yet identified**
    - **Cost**
  - **Spool Assembly**
    - **Vendors not yet identified**
    - **Cost**

- **Mitigation**
  - **RFP for superconductor will be sent out in October 04**
  - **Meetings with potential vendors and CERN personnel have begun**
  - **Letters of interest have been sent out to various Labs**
    - **Vendor visits will soon follow**
  - **Enough resources are currently allocated to speedup the design process in an effort to get a budgetary cost estimate from a potential vendor**

Summary

- A cost estimate based on the design report has been presented
  - Total Base Cost including G&A = 17,083 k$ in FY05 $
- Cost and Schedule has been loaded into OpenPlan
- Most of the WBS Dictionary elements and Basis of Estimate have been completed
- A bottoms-up contingency analysis needs to be completed
- We need to continue technical progress, detail design development and vendor interactions to baseline the cost for CD2